

indication that the wound environment enhancement provided by topical interventions has been successful.

Indications that the right choice has been made and that the wound is progressing to healing include:

- **healthy or improving periwound skin**
- **healthy wound bed with no sign of infection**
- **reduced dressing change requirements**
- **lack of or reduction in wound odour**
- **reduction in or lack of wound pain.**

When do I need to think again?

The complications that may arise from poor exudate management are significant. Regular reassessment is necessary to highlight continued or emerging problems, and to prompt adjustments in management. When there is lack of progress, reassessment should include examination for factors beyond the wound that may be creating a barrier to healing. In addition, specialist referral may be considered.

Signs of lack of progress include:

- **the patient's quality of life is not improving**
- **the periwound skin remains**

unhealthy and/or the wound is extending

- **the wound bed shows signs of increasing bacterial load**
- **there is soiling outside the dressing**
- **the patient has made adjustments to dressing arrangements to accommodate the exudate**
- **dressing changes are very frequent**
- **wound odour is uncontrolled**
- **wound pain is continuing.**

Management with topical negative pressure

In recent years, topical negative pressure wound therapy has revolutionised the management of heavily exuding wounds²⁴. In the context of exudate management, it is especially useful when soiling and leakage pose significant problems and when frequent dressing changes are very painful. It has been used in a wide range of wound types, including diabetic foot ulcers and pressure ulcers and has proved particularly useful in the management of sternal and open abdominal wounds.

Topical negative pressure wound therapy must be used appropriately, giving consideration to contraindications, the type and location of the wound, resources required and practitioner competencies²⁴.

Management with fluid collection devices

Fluid collection devices (eg wound management, stoma or urostomy bags) are useful when exudate levels are high and draining from an area where the surrounding skin can support an adhesive flange. Collection devices are available that may be suitable for a range of wound sizes, from small discrete wounds, eg small surgical wounds or drain sites, to large wounds such as dehisced abdominal wounds.

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Further reading

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Introduction

Exudate production by open wounds is essential for moist wound healing. However, when wounds produce insufficient or too much exudate, and/or the composition of the exudate is harmful, a wide range of problems can occur that ultimately delay healing, distress patients and consume considerable healthcare resources. This document builds on the principles presented in the document *Wound exudate and the role of dressings*¹, and focuses on how a rigorous approach to exudate management can improve patient quality of life, promote healing and enhance healthcare effectiveness.

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What is exudate?

Exudate can be defined as fluid leaking from a wound. It plays a central role in healing.

Exudate is mainly water, but also contains electrolytes, nutrients, proteins, inflammatory mediators, protein digesting enzymes (eg matrix metalloproteinases (MMPs)), growth factors and waste products, as well as various types of cells (eg neutrophils, macrophages and platelets)². Although wound exudate frequently contains micro-organisms, their presence does not necessarily mean that the wound is infected³. Exudate is usually clear, pale amber and of watery consistency⁴. In general, it is odourless, although some dressings produce a characteristic odour that may be mistaken as coming from exudate.

Wound exudate should be evaluated in the context of the wound tissue type being treated. For example, exudate produced by a necrotic wound as a result of autolytic or enzymatic debridement would characteristically be opaque and tan, grey or even green (if the wound contains certain bacteria). This exudate may also present with a foul odour.

What does exudate do?

In **healing wounds**, exudate supports healing and a moist wound environment. The main role of exudate is in

facilitating the diffusion of vital healing factors (eg growth and immune factors) and the migration of cells across the wound bed⁵. It also promotes cell proliferation, provides nutrients for cell metabolism, and aids autolysis of necrotic or damaged tissue.

What affects rate of exudate production?

As healing occurs, the amount of exudate produced usually decreases⁵. It is important to recognise that the volume of exudate is related to the surface area of the wound, and therefore large wounds such as burns, venous leg ulcers and skin donor sites often produce higher volumes of exudate⁶.

Although a moist wound environment is necessary for optimal wound healing⁷, over- or under-production of exudate may adversely affect healing.

Any factor that increases capillary leakage or predisposes to the development of tissue oedema (eg inflammation, bacterial contamination or limb dependency) may boost exudate production. Low exudate production may indicate a systemic problem, eg dehydration, hypovolaemic shock, microangiopathy, or may be a feature of ischaemic ulcers¹.

When too much or too little exudate is produced, it is essential that the healthcare professional accurately determines and evaluates the factors contributing to the problem. Only then can effective management strategies be introduced.

Why does exudate sometimes cause healing problems?

In **wounds not healing as expected** (ie chronic wounds), exudate appears to impede healing – it:

- **slows down or even prevents cell proliferation**
- **interferes with growth factor availability**
- **contains elevated levels of inflammatory mediators and activated MMPs⁸⁻¹⁰.**

The increased proteolytic activity of chronic wound exudate is implicated in perpetuating wounds, damaging the wound bed, degrading the extracellular matrix, and causing periwound skin problems^{11,12}.

Alterations in the characteristics of exudate, eg in colour, quantity, odour or consistency, may have particular

Summary

Exudate production is a normal feature of healing wounds. However, when the exudate produced is too much, too little or of the wrong composition, a wide variety of problems can occur, ranging from psychosocial issues to delayed healing. Careful attention to contributory factors and to local management can help to reduce the likelihood of problems, encourage healing and avoid unnecessary health burden costs.

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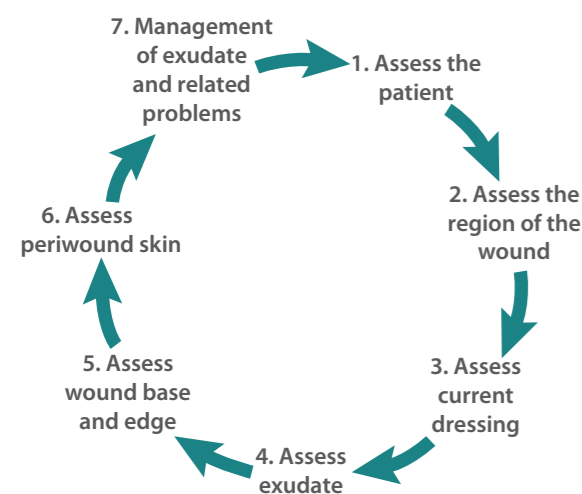
significance^{1,13}. Any unexpected change in exudate characteristics may indicate a change in wound status or concomitant disease process and should prompt re-evaluation – see: *Wound exudate and the role of dressings*¹.

Why is it important to manage exudate?

Effective exudate management can reduce time to healing, reduce exudate-related problems such as periwound skin damage and infection, improve patients' quality of life, reduce dressing change frequency and clinician input, and so, overall, improve healthcare efficiency.

Comprehensive assessment underpins effective exudate management, and ideally should be integrated into general wound assessment (Figure 1). Assessment should identify any wound-related, local, systemic or psychosocial factors that may be contributing to exudate-related problems.

Figure 1 Integration of exudate assessment (adapted from¹)



How do I know when exudate is not being managed properly?

Exudate is a problem when any of the following occurs:

- leakage and soiling
- periwound skin changes, eg maceration, denudation (skin stripping or erosion)
- delayed healing
- odour
- discomfort/pain
- infection
- protein loss/fluid and electrolyte imbalance
- need for frequent dressing changes
- psychosocial problems – exudate-associated leakage, soiling, odour, pain and the requirement for frequent dressing changes may distress patients and carers and result in social isolation¹.

Insufficient exudate may be associated with delayed healing, delayed autolysis, dressing adherence and pain on dressing removal.

What is the role of dressings?

In many cases, the overall aim of exudate management is to achieve a wound bed that is sufficiently moist for healing (see Table 1), but that does not cause problems such as maceration, whilst treating underlying contributory factors, enhancing patient quality of life, encouraging healing, addressing exudate-related problems and optimising healthcare resource use^{1,14} (Figure 2).

Dressings are the main option for managing exudate at wound level. Table 2 presents dressing-related strategies that can be employed to increase, maintain or reduce wound moisture.

Where excessive exudate is a problem, or where exudate composition is suspected of impeding healing, removal of exudate from the wound bed is a priority.

How do I choose an appropriate dressing?

There are numerous dressings available, ranging from simple dressings consisting of one material, to more sophisticated multilayered dressings that combine several modes of fluid handling. The materials used in dressings vary in the way that they handle fluid and may have other properties. Developing an understanding of how dressing materials function will assist clinicians in making appropriate dressing product choices according to individual patient's needs.

In addition to fluid handling capability, the dressing selected should promote a wound

Table 1 Evaluation of dressing–exudate interaction (adapted from¹)

Status	Indicators	Dressing	Surrounding skin
Dry May be the environment of choice for ischaemic wounds	Wound bed is dry; there is no visible moisture	Primary dressing is unmarked; dressing may be adherent to wound	Skin may be scaly, atrophic, hyperkeratotic
Moist Aim of exudate management in many cases	Small amounts of fluid are visible when dressing is removed; wound bed may appear glossy	Primary dressing may be lightly marked; dressing change frequency is appropriate	Skin is likely to be intact, hydrated, no lesions
Wet	Small amounts of fluid are visible when the dressing is removed	Primary dressing is extensively marked, but strikethrough does not occur; appropriate dressing change frequency	Initial fragmented areas of maceration may be apparent
Saturated	Free fluid is visible when the dressing is removed	Primary dressing is wet and strikethrough occurs; dressing change is required more frequently than usual	Macerated or denuded periwound skin may encircle the wound
Leaking	Free fluid is visible when the dressing is removed	Dressings are saturated and exudate is escaping from primary and secondary dressings onto clothes or beyond; dressing change is required much more frequently than usual	Periwound skin is likely to be macerated or denuded with extensive involvement

Table 2 Strategies for achieving the desired moist wound environment (adapted from¹)

Aim	Strategies*
Increase wound moisture	<ul style="list-style-type: none"> ▪ Reassess patient management to ensure appropriate treatment is in place ▪ Choose dressing type that conserves, maintains or adds moisture ▪ Use thinner (less absorbent) version of current dressing ▪ Decrease dressing change frequency ▪ If problems continue or worsen, refer for specialist opinion
Maintain wound moisture	<ul style="list-style-type: none"> ▪ Continue current dressing regimen if wound is making satisfactory progress towards treatment goals ▪ Reconsider dressing choice or consider specialist referral if progress towards treatment goals is unsatisfactory
Reduce wound moisture	<ul style="list-style-type: none"> ▪ Reassess patient management to ensure appropriate treatment is in place (eg systemic interventions, or elevation or compression where appropriate) ▪ Use thicker (more absorbent) version of current dressing ▪ Change to dressing type of greater fluid handling capacity ▪ Add or use higher absorbency secondary dressing ▪ Increase frequency of primary and/or secondary dressing change ▪ If problems continue or worsen, refer for specialist opinion

*It is important to review strategies regularly and to expect need for adjustment

environment that will encourage healing, prevent further problems and meet the patient's individual needs¹⁵. Other considerations will include:

- ease of application, comfort, conformability
- length of wear/frequency of dressing change required
- retention of exudate within the dressing
- avoidance of maceration/denudation
- ease of removal
- ability to reduce pain on application and removal and during wear

- if used under compression, ability to retain fluid under pressure
- cost-effectiveness.

Only by careful assessment of the current dressing–wound interaction can appropriate decisions be made regarding future dressing selection (Table 1). Any decisions made to change the dressing regimen need to be taken in the overall context of the patient's wound, concomitant conditions, psychosocial status and wishes.

How do dressing materials retain fluid?

Many dressing materials handle fluid by absorbing it and/or allowing it to evaporate. Simple absorptive dressing materials that take fluid up into spaces in their structure, eg cotton, viscose or polyester textiles and simple polyurethane or silicone foams, are not able to retain liquid under pressure. Some dressing materials, eg hydrocolloids, carboxymethylcellulose (CMC) fibres (Hydrofiber® Technology) and, to an extent, alginates, can retain a high proportion of absorbed fluid when compressed by taking up liquid to form a gel¹⁶.

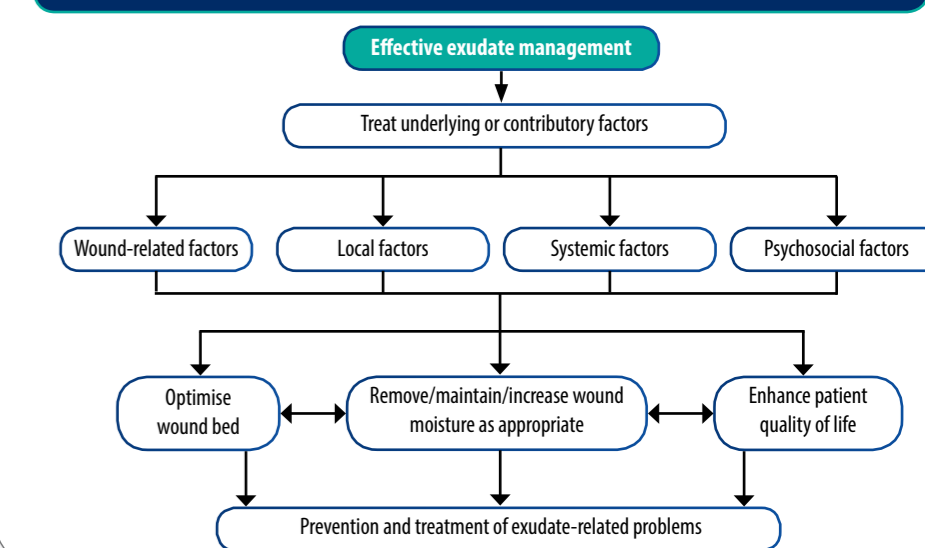
Dressing materials are frequently available in several different forms, eg flat sheets of varying thickness, pastes and ropes. Increasingly, individual dressing products combine layers or pockets of different types of dressing materials. For example, dressings may consist of a wound contact layer, an absorbent layer and a non-permeable or semi-permeable backing. As a result, the fluid handling characteristics and usages of individual dressings of the same broad type may vary considerably¹.

How do I avoid skin maceration?

Periwound skin changes have a number of causes including: contact with exudate, dressing sensitivity/allergy or a dermatological condition. The likelihood of exudate-related changes can be reduced by minimising skin contact with exudate by employing a dressing and regimen appropriate to the level of exudate production, and, if appropriate, using a suitable skin barrier and atraumatic dressings and methods of fixation.

CMC fibres (Hydrofiber® Technology) have been shown to form a gel that prevents lateral movement of fluid

Figure 2 Principles of effective exudate management (adapted from¹)



within the dressing^{16,17}. This property may help to protect periwound skin^{18,19}.

How can I increase wound moisture?

In some situations, wound healing and autolysis are delayed because there is insufficient moisture in the wound. Occlusive dressings (such as those with a semi-permeable film backing or that contain hydrocolloids) or those that donate moisture (such as hydrogels) can increase wound moisture content. Some combination dressings are intended to maintain a moist wound environment whilst absorbing exudate.

What do we know about the effects of dressings on exudate composition?

It has been suggested that some dressing materials have the potential to alter the composition of exudate in ways that may prove to be beneficial to healing¹.

For example, CMC fibres and some alginates, have been shown *in vitro* to trap bacteria and exudate components such as proteolytic enzymes along with fluid²⁰.

Laboratory studies have also shown that some dressing materials, eg CMC, collagen/oxidised-regenerated cellulose and some forms of hyaluronan, are able to reduce free radical activity^{21,22}. Free radicals are produced as part of the inflammatory process and have been implicated in the perpetuation of wounds²³.

How do I know when I have made the right choice?

Regular comprehensive assessment and documentation of the wound are essential for monitoring change and aiding decision-making. Documented improvement of the wound and progression towards treatment goals (usually healing) provide a clear